FUNCTIONAL COORDINATION OF A FULL-BODY GAZE CONTROL MECHANISMS ELICITED DURING LOCOMOTION

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Control of locomotion requires precise interaction between several sensorimotor subsystems. Exposure to the microgravity environment of spaceflight leads to postflight adaptive alterations in these multiple subsystems leading to postural and gait disturbances. Countermeasures designed to mitigate these postflight gait alterations will need to be assessed with a new generation of functional tests that evaluate the interaction of various elements central to locomotor control. The goal of this study is to determine how the multiple, interdependent, full- body sensorimotor subsystems aiding gaze stabilization during locomotion are functionally coordinated.

To explore this question two experiments were performed. In the first study (Study 1) we investigated how alteration in gaze tasking changes full-body locomotor control strategies. Subjects (n=9) performed two discreet gaze stabilization tasks while walking at 6.4 km/hr on a motorized treadmill: 1) focusing on a central point target; 2) reading numeral characters; both presented at 2m in front at eye level. The second study (Study 2) investigated the potential of adaptive remodeling of the full-body gaze control systems following exposure to visual-vestibular conflict. Subjects (n=14) walked (6.4 km/h) on the treadmill before and after they were exposed to 0.5X minifying lenses worn for 30 minutes during self-generated sinusoidal vertical head rotations performed while seated. In both studies we measured: temporal parameters of gait, full body sagittal plane segmental kinematics of the head, trunk, thigh, shank and foot, accelerations along the vertical axis at the head and the shank, and the vertical forces acting on the support surface.

Results from Study 1 showed that while reading numeral characters as compared to the central point target: 1) compensatory head pitch movements were on average 22% greater 2) the peak acceleration measured at the head was significantly reduced by an average of 13% in four of the six subjects 3) the knee joint total movement was on average 11% greater during the period from the heel strike event to the peak knee flexion event in stance phase of the gait cycle. Results from Study 2 indicate that following exposure to visual-vestibular conflict changes in full-body strategies were observed consistent with the requirement to aid gaze stabilization during locomotion.

Taken together, results from Studies 1 and 2 provide evidence that the full body contributes to gaze stabilization during locomotion, and that different functional elements are responsive to changes in visual task constraints and are subject to adaptive alteration following exposure to visual-vestibular conflict. These studies also successfully validate new integrated methodologies designed to assess locomotor function for countermeasure evaluation and validation.